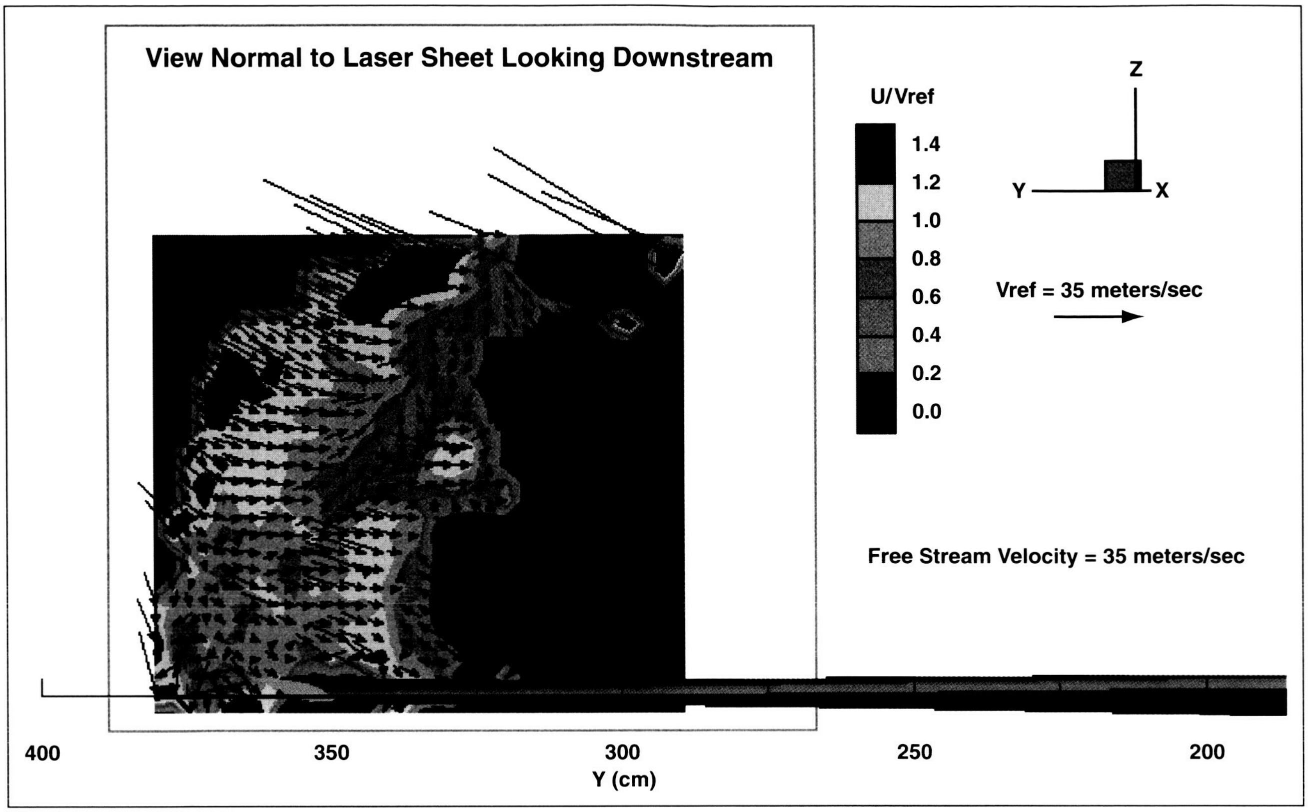

Fig 2. Orthogonal velocity vector field processed from a single-pulse measurement (view is normal to the measurement plane looking downstream).

Photonic Switching Using Light Bullets

Peter M. Goorjian

The objective of this work was to develop a faster, more efficient data switch for use in optical communications networks and optical signal processing systems. An optical device has been developed to perform ultrafast, all-optical switching by using light bullets to switch light bullets. This invention was granted U.S. Patents 5,651,079, July 22, 1997 and 5,963,683, October 5, 1999; it was based on computer simulations of the interactions of light bullets.

The rapid proliferation of information technology in commerce, finance, education, health, government, security, and entertainment, together with the ever-increasing power of computers and data storage devices, is fueling a potentially massive demand for network interconnections, especially broadband services. Switching is an essential operation of all communications networks and digital computers and signal processing systems. Switching is presently a limiting factor in the speed of operation of optical communications and computing, because most commercial devices must use electrical forms of switching, and in the longer term electronic systems will become increasingly complex and costly. Network designers will turn increasingly to photonic transport and switching technologies. An all-optical switch would have the inherent advantages of higher speed and higher efficiency.

One such all-optical switch has been designed at Ames Research Center. In the NASA switch configuration, light bullets propagate through, and interact nonlinearly with, each other within a planar slab waveguide to selectively change each other's directions of propagation into predetermined output channels. The resulting performance should enable low-power, high-speed switching in a small device.

Possible materials include nonlinear glasses, semiconductor crystals, and multiple quantum-well semiconductors. The patents describe the necessary material parameters, including negative group velocity dispersion, nonlinear index of refraction, and wavelength of light, that are required in order for the light bullets to interact and selectively change each other's direction of propagation.

The figure shows the results of a computer simulation of two counter-propagating light bullets at four instants in time. As they collide with each other, they deflect each other through attraction. This deflection is the basis of a light switch, that is, where light switches light.

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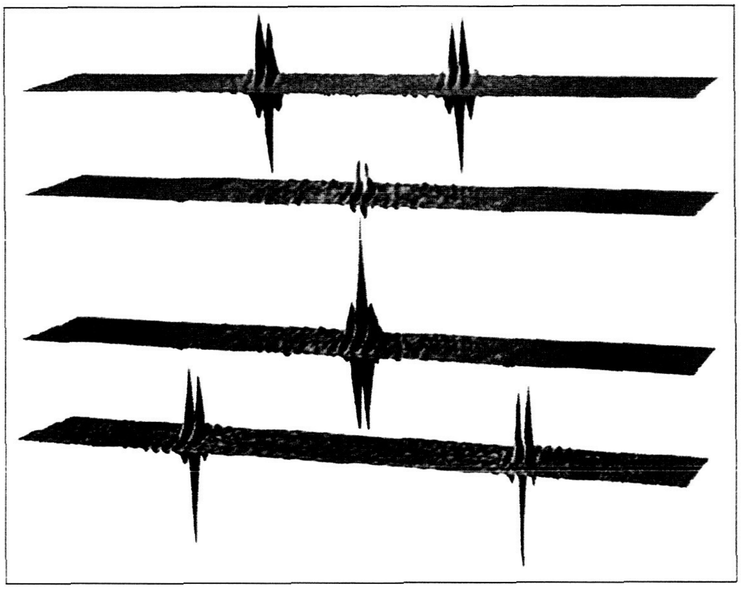

Fig. 1. Collision of two counter-propagating light bullets.

A Computational Model of Situational Awareness

Robert J. Shively

Situational awareness (SA) is a term that has great intuitive appeal, especially in aviation. Although often invoked in a descriptive manner, SA is difficult to precisely define. As a result, a computational, mathematically defined model of SA has been developed. The goal of the modeling effort was to enhance researcher communication and to advance efforts to improve pilot SA and performance through improved display design or aircrew procedures.

The Computational Situational Awareness (CSA) model is composed of two essential features: situational elements and situation-specific nodes. Situational elements (SEs) are relevant information in the environment that define the circumstances (for example, other aircraft, obstacles, way points, ownship parameters). The pilot experiences these elements through perception, experience, or a preflight briefing. Each SE has a mathematical weight based upon its importance in the situation and a